

1 **WE CLAIM:**

2 1. A process for the production of low base number
3 calcium sulfonates comprising:

4 a. preparing a sulfonic acid-oil solution by adding
5 about 1 to about 20 volumes of a miscible
6 solvent to a sulfonic acid-oil feedstock and
7 optionally removing dissolved or entrained SO₂
8 or SO₃ if present;

9 b. mixing the sulfonic acid-oil solution with
10 about 1 to about 5 moles of water per mol of
11 sulfonic acid and about 1 to about 10 moles of
12 calcium hydroxide per mole of sulfonic acid to
13 provide a reaction mixture;

14 c. heating the reaction mixture to a temperature in
15 the range of about 40 °C to about 200 °C;

16 d. separating excess calcium hydroxide from the
17 heated-reaction mixture to produce a reaction
18 product comprising solvent, oil, and calcium
19 sulfonate;

20 e. removing the solvent from the reaction product
21 to produce an intermediate product comprising
22 oil and calcium sulfonate;

23 f. optionally concentrating the intermediate
24 product by removing at least a portion of the
25 oil to produce a concentrated product; and

26 g. recovering the intermediate product and/or
27 concentrated product, wherein the product is
28 essentially chloride free calcium sulfonate in
29 oil.

1 2. The process of claim 1 in which the dissolved or
2 entrained SO₂ or SO₃ if present is removed from the
3 sulfonic acid solution.

1 3. The process of claim 1 in which the solvent is
2 heptane.

1 4. The process of claim 2 in which the dissolved or
2 entrained SO₂ or SO₃ is removed via stripping with
3 nitrogen.

1 5. The process of claim 4 in which the sulfonic acid is
2 centrifuged prior to stripping.

- 1 6. The process of claim 1 in which the amount of water
2 is from about 1 to about 3 mol/mol of sulfonic acid.
- 1 7. The process of claim 1 in which the amount of
2 calcium hydroxide is about 1 to about 5 mol/mol of
3 sulfonic acid.
- 1 8. The process of claim 1 in which reaction mixture is
2 heated at a temperature in the range from about 80
3 °C to about 140 °C.
- 4 9. The process of claim 1 in which the reaction mixture
5 is mixed for a period of time up to 60 minutes.
- 1 10. The process of claim 1 in which the reaction
2 mixture is mixed for a period of time up to 30
3 minutes.
- 1 11. The process of claim 1 in which excess calcium
2 hydroxide is separated from the reaction mixture by
3 centrifugation.
- 1 12. The process of claim 11 in which the
2 centrifugation is performed for less than about 20
3 minutes.
- 1 13. The process of claim 1 in which the
2 intermediate product is concentrated by a method
3 selected from the group consisting of distillation
4 and vacuum flashing.
- 1 14. The process of claim 1 in which the process is
2 a continuous process.
- 1 15. The process of claim 2 in which the solvent is
2 heptane, the dissolved or entrained SO₂ or SO₃ is
3 removed via stripping with nitrogen, , and the
4 intermediate product is concentrated by a method
5 selected from the group consisting of distillation
6 and vacuum flashing.
- 1 16. The process of claim 15 in which the process is
2 a continuous process.
- 1 17. The process of claim 15 in which the
2 centrifugation to remove excess calcium hydroxide is
3 performed for less than about 20 minutes.
- 1 18. The process of claim 15 in which the calcium
2 sulfonate in oil has a viscosity of between about 10

3 cSt/100°C and about 100 cSt/100°C.

1 19. The process of claim 18 in which the process is
2 a continuous process.

1 20. The process of claim 19 in which the product is
2 further concentrated by distillation.

3 21. A process for the production of low base number
4 calcium sulfonate comprising:

- 5 a. preparing a sulfonic acid solution in oil by
6 adding about 1 to about 20 volumes of a
7 miscible solvent to sulfonic acid and removing
8 dissolved or entrained SO₂ or SO₃ if present;
- 9 b. mixing the sulfonic acid solution in oil with
10 about 1 to about 5 moles of water per mol of
11 sulfonic acid and about 1 to about 10 moles of
12 calcium hydroxide per mole of sulfonic acid to
13 produce a reaction mixture;
- 14 c. heating the reaction mixture with stirring to a
15 temperature between about 40 °C and about 200
16 °C;
- 17 d. separating excess calcium hydroxide from the
18 heated-reaction mixture; and,
- 19 e. recovering the essentially chloride free
20 calcium sulfonate product from the separated-
21 reaction mixture.

1 22. The process of claim 21 in which the product
2 after solvent removal is further concentrated by
3 removing at least a portion of the oil.

4 23. The process of claim 22 in which the oil is
5 removed by a method selected from the group
6 consisting of distillation and vacuum flashing.

7 24. The process of claim 21 in which the dissolved
8 or entrained SO₂ or SO₃ is removed via stripping with
9 nitrogen.

1 25. The process of claim 24 in which the sulfonic
2 acid is centrifuged prior to stripping.

1 26. The process of claim 21 in which the amount of
2 water is from about 1 to about 3 mol/mol of sulfonic
3 acid.

- 1 27. The process of claim 21 in which the amount of
2 calcium hydroxide is about 1 to about 5 mol/mol of
3 sulfonic acid.
- 1 28. The process of claim 21 in which reaction
2 mixture is heated at a temperature in the range
3 from about 80 °C to about 140 °C.
- 4 29. The process of claim 21 in which the reaction
5 mixture is mixed for a period of time up to 60
6 minutes.
- 1 30. The process of claim 21 in which the reaction
2 mixture is mixed for a period of time up to 30
3 minutes.
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